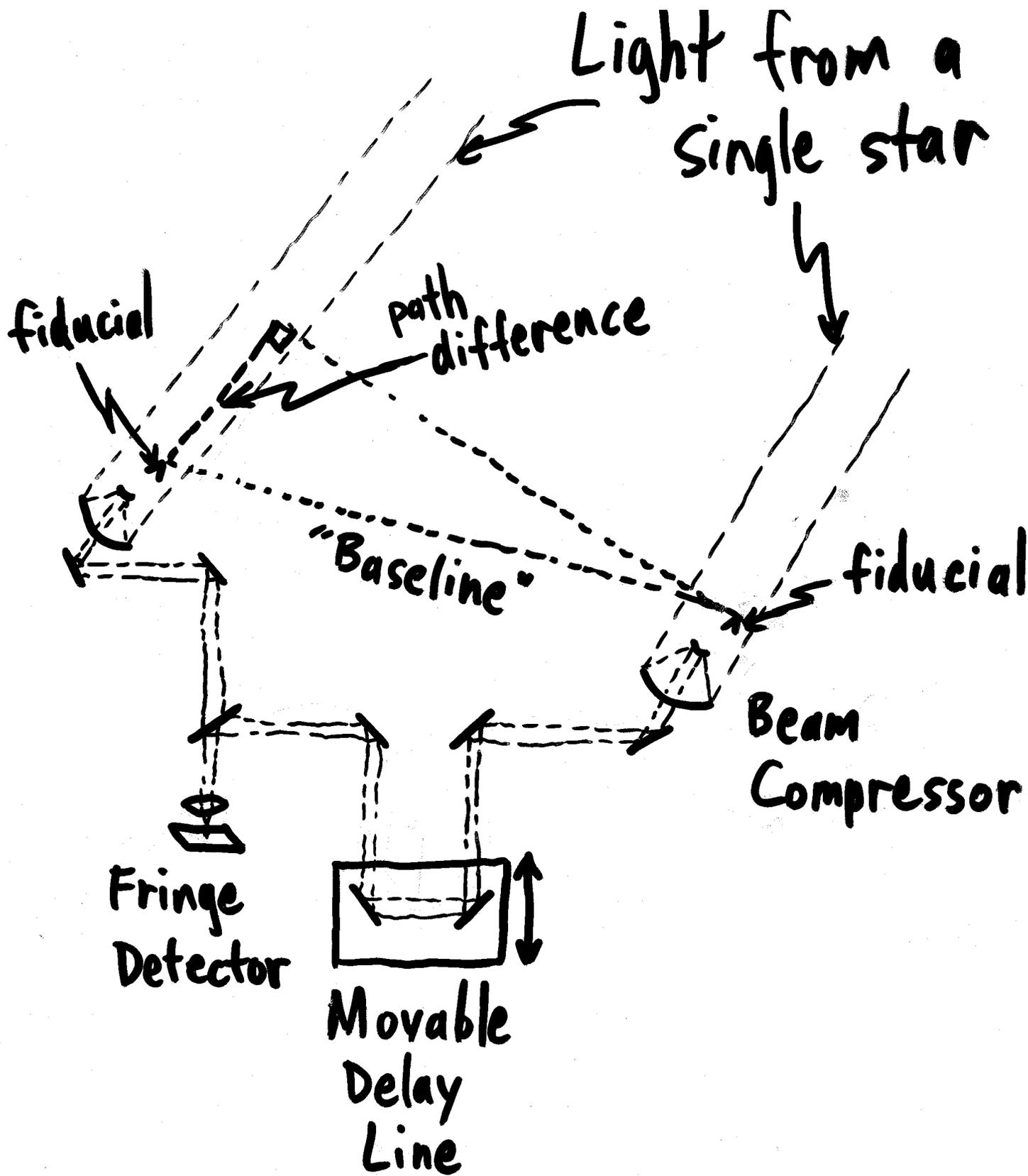
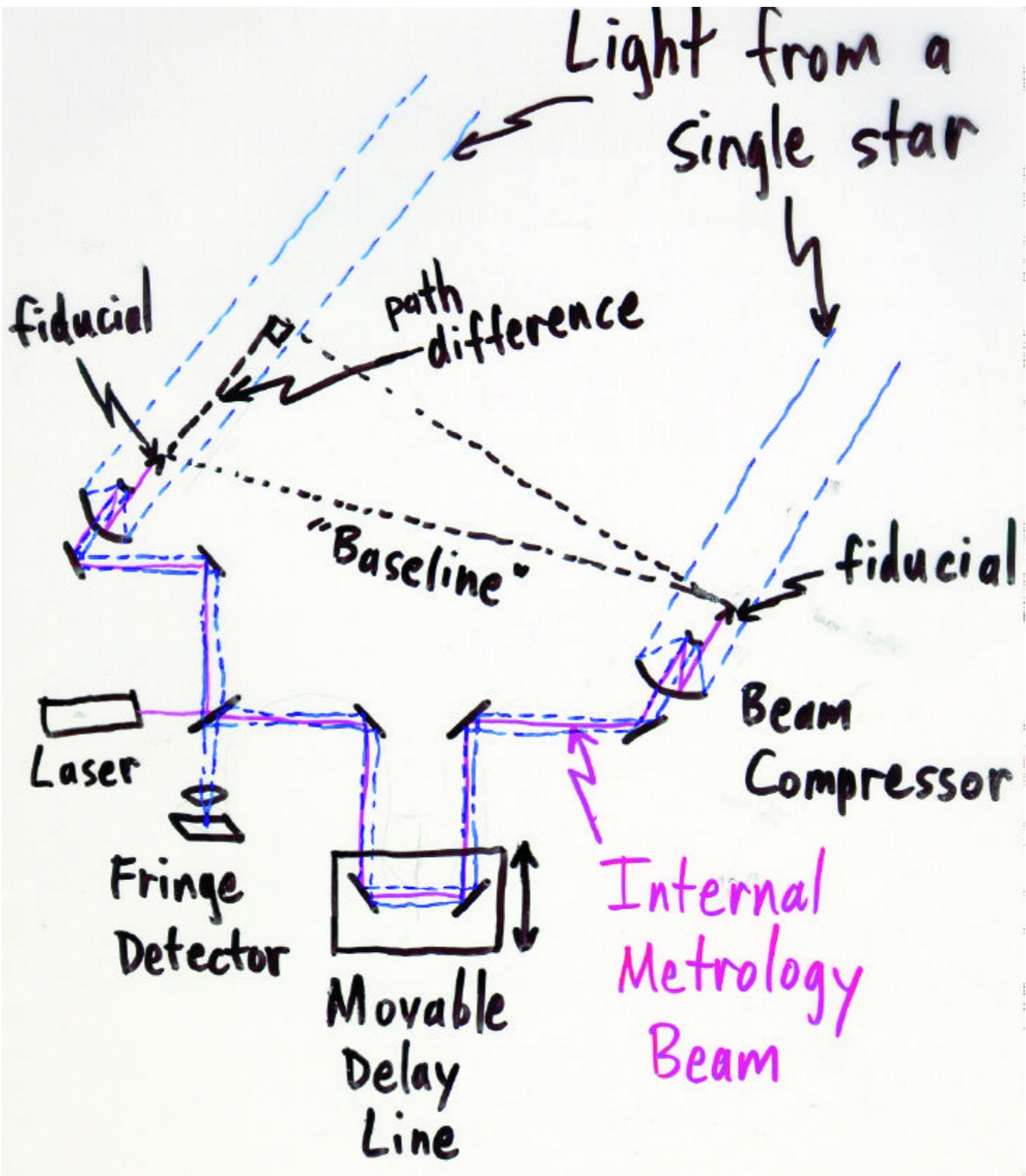


Using SMACOS to perform an analysis of a full aperture metrology (FAM) system

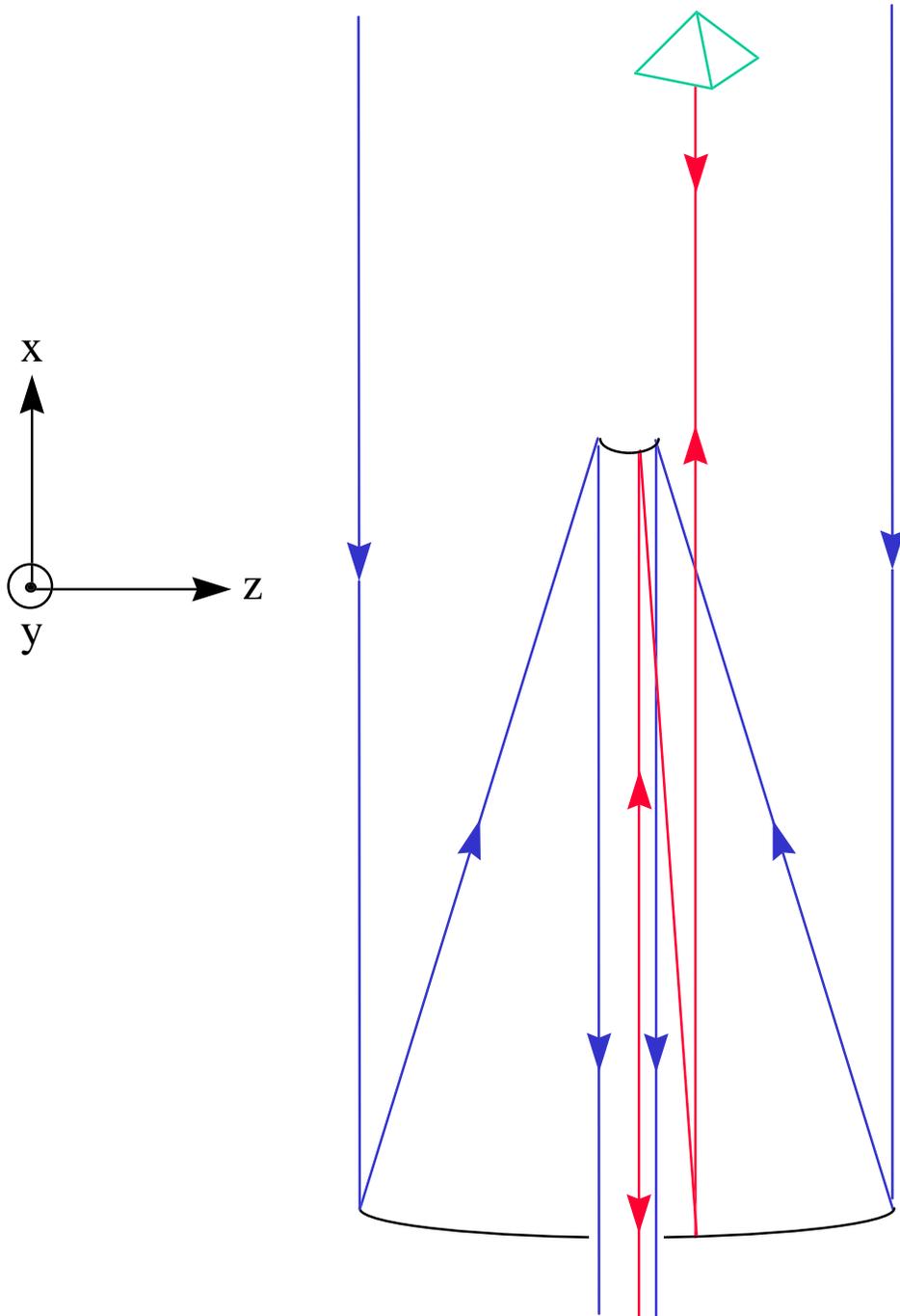
Scott A. Basinger
Jet Propulsion Laboratory

IMOS Workshop 1998





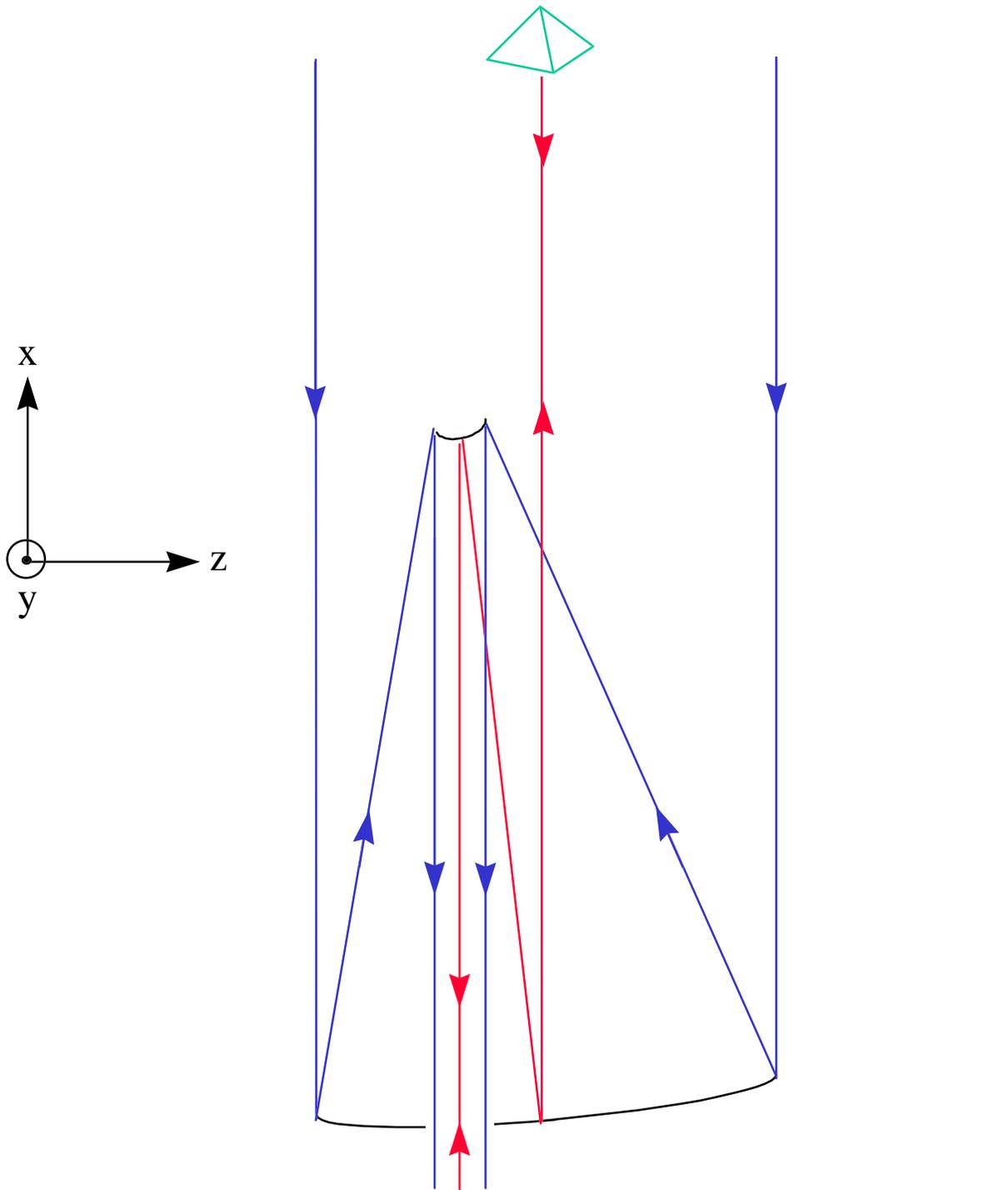
On-axis beam compressor for interferometric telescope



- Starlight path
- Metrology ray
- ◊ Corner cube

magnification = 1/11

Off-axis beam compressor for interferometric telescope



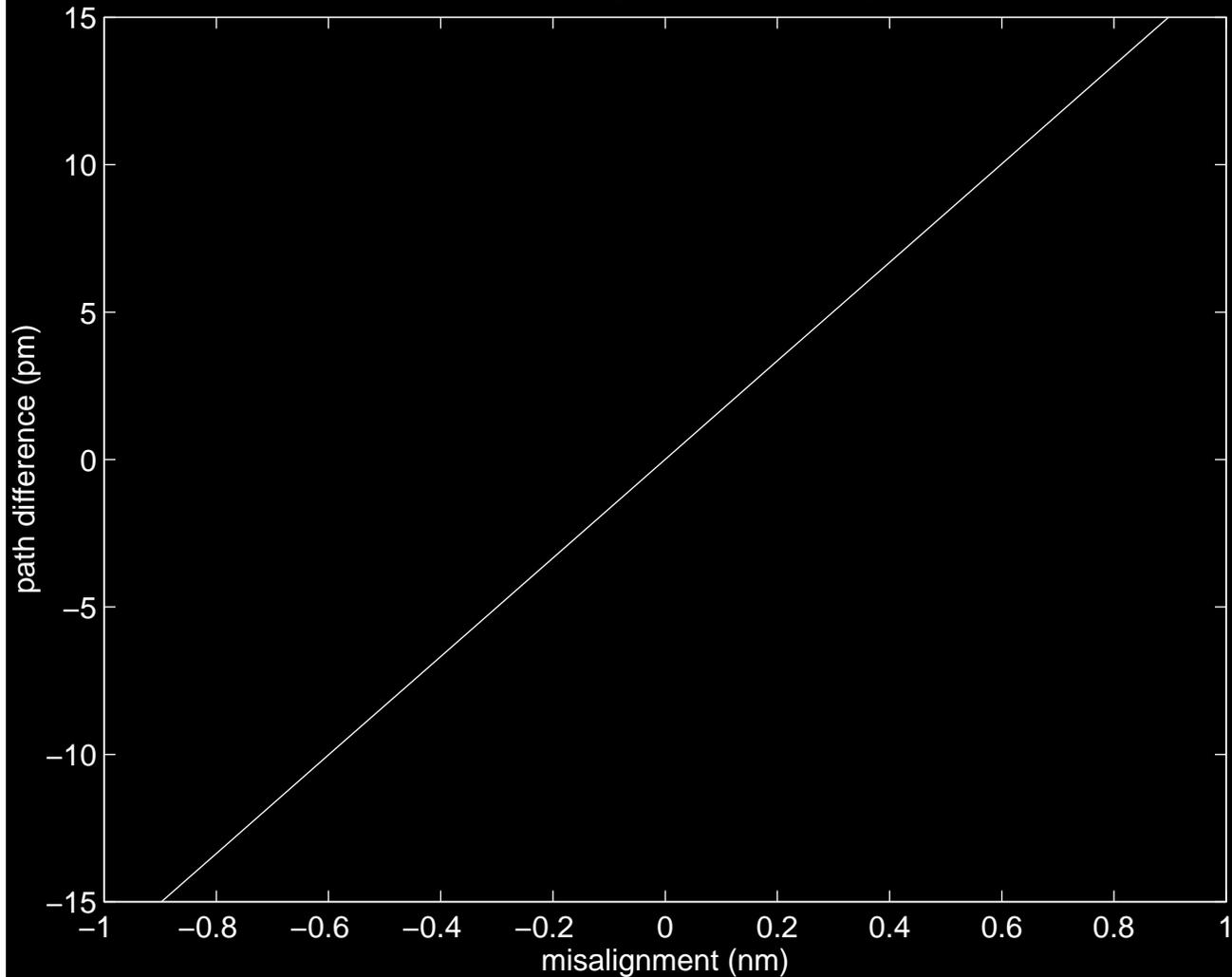
- Starlight path
- Metrology ray
- ◊ Corner cube

magnification = 1/11

Steps To Perform Analysis

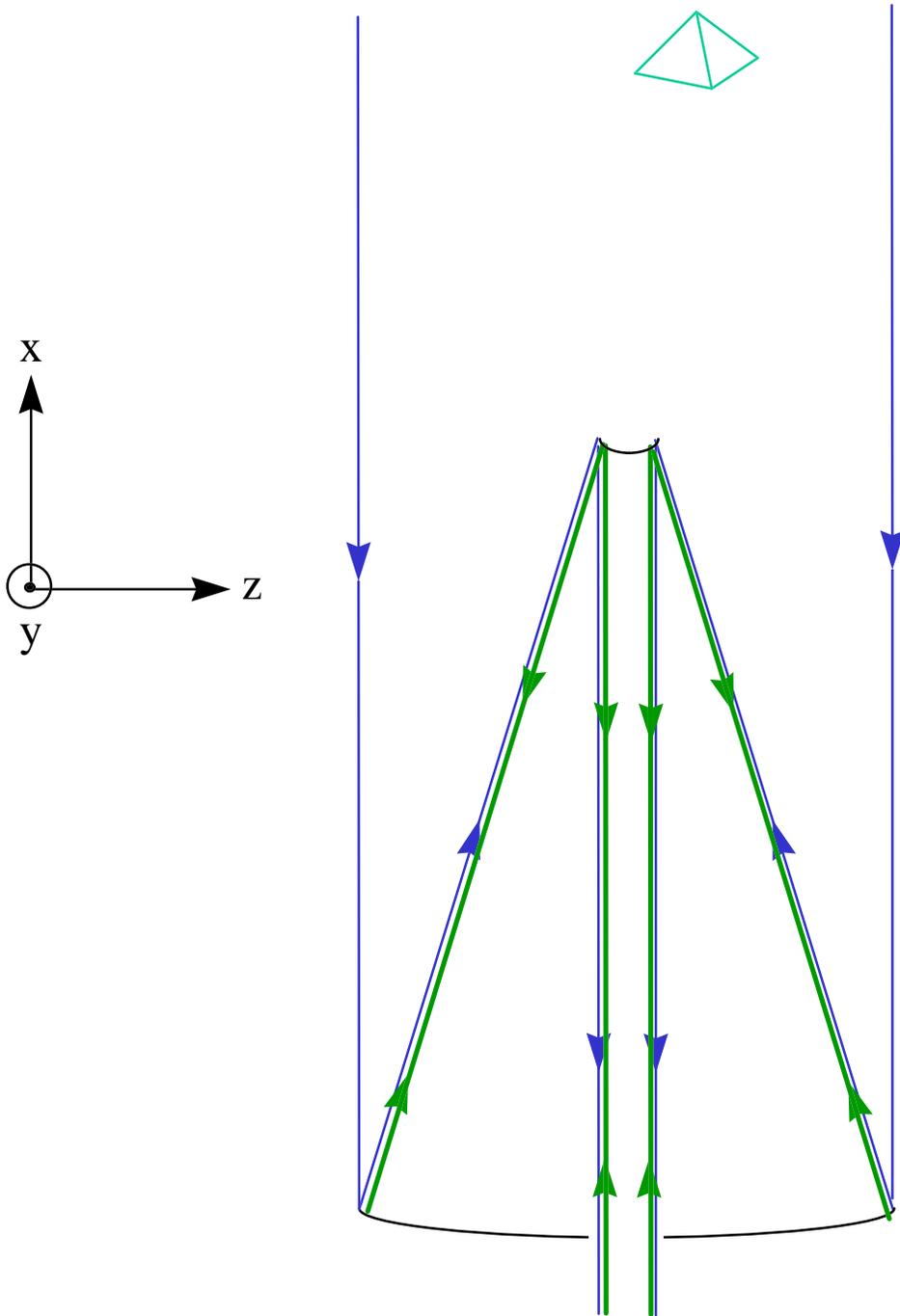
- I. Design optical system (Code V, Zeemax, etc.)
- II. Use MACOS to create prescription file from nominal design
 - A. Include same optical elements as in Code V or Zemax (plus more)
 - B. Include all apertures and obscurations
 - C. Can do diffraction analysis, if necessary
 - D. Each “system” requires a separate prescription file (starlight, metrology, FAM, FAM metrology)
- III. Write FORTRAN code to exercise model in SMACOS
 - A. Perturb optical elements
 - B. Perform wavefront analysis
 - C. Move actuators (fast steering mirrors, switchyard mirrors)
 - D. Perform wavefront analysis (again)
 - E. Compile and analyze results
 - F. Save data to files
- IV. Read data into MATLAB to perform additional statistical analysis, if necessary

Difference Between Starlight Path & Metrology vs. Despace



Description of Displacement	Displacement or angle to cause 10 pm error between starlight and metrology	
	on-axis beam compressor	off-axis beam compressor
whole assembly rotates about corner cube	3.1 arcsec	2.9 arcsec
secondary tip-tilt	0.040 arcsec	0.021 arcsec
despace (\hat{x})	0.76 nm	0.60 nm
decenter (\hat{y})	$> 1 \mu\text{m}$	$> 1 \mu\text{m}$
decenter (\hat{z})	110 nm	5.6 nm

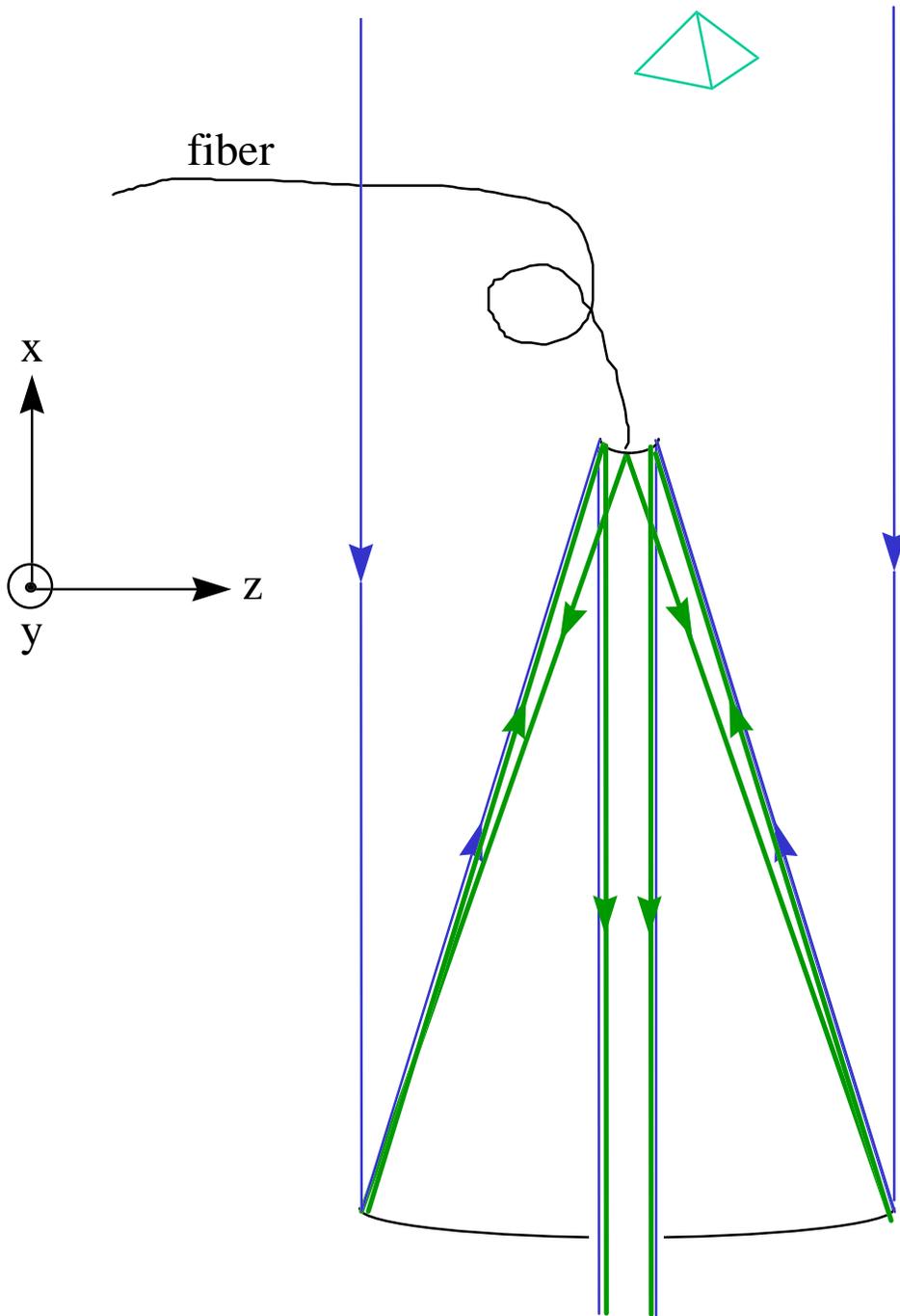
FAM as HOE on primary



- Starlight path
- FAM ray
- ◊ Corner cube

magnification = 1/11

Fiber FAM and HOE on primary

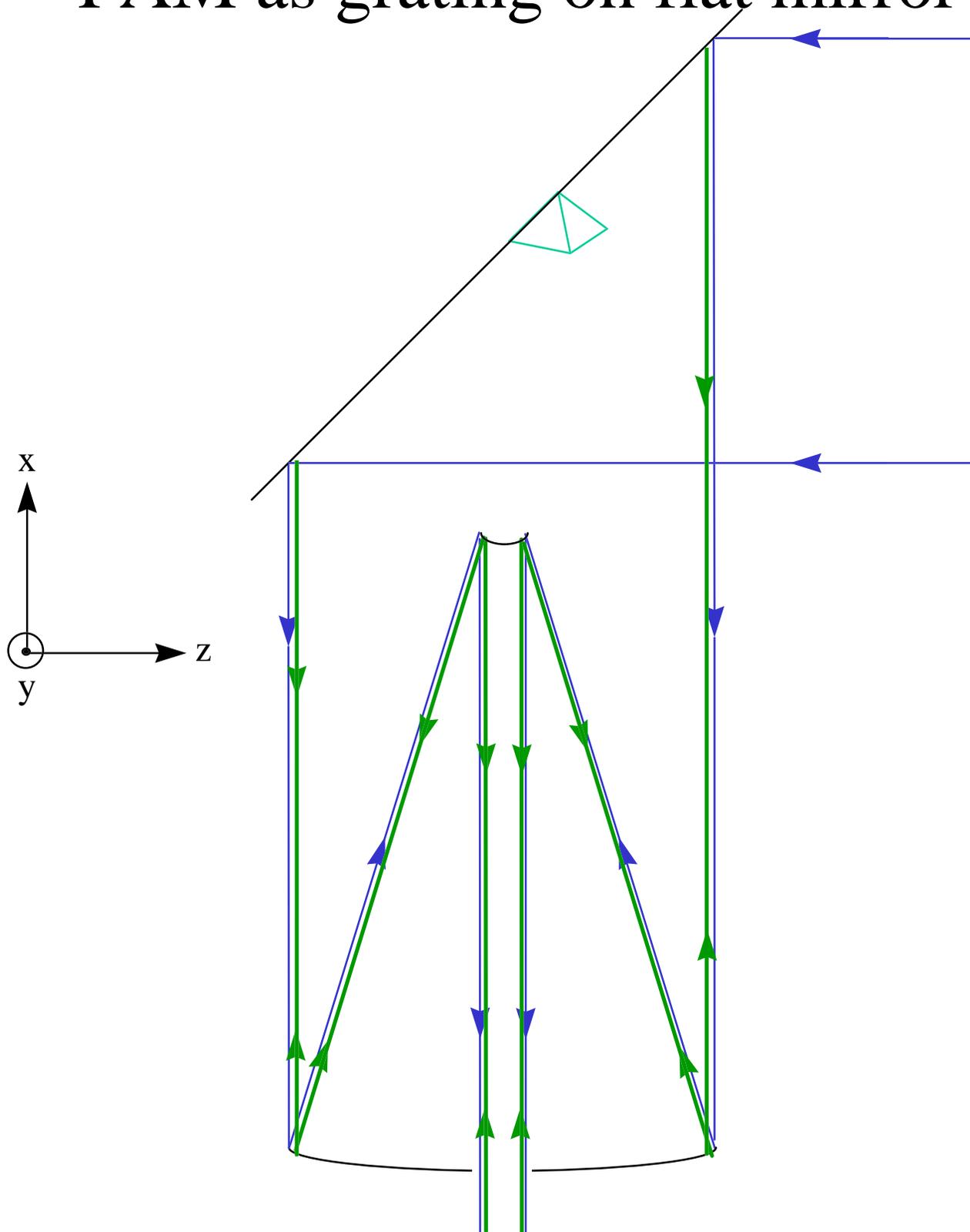


- Starlight path
- FAM ray
- ◊ Corner cube

magnification = 1/11

Description	Displacement or angle to cause 10 pm error	
	off-axis, no FAM	off-axis, HOE on primary
whole assembly rotates about corner cube	2.9 arcsec	17.0 arcsec
secondary tip-tilt	0.021 arcsec	0.290 arcsec
despace (\hat{x})	0.60 nm	8.10 nm
decenter (\hat{y})	$> 1 \mu\text{m}$	$> 1 \mu\text{m}$
decenter (\hat{z})	5.6 nm	85 nm

FAM as grating on flat mirror



— Starlight path

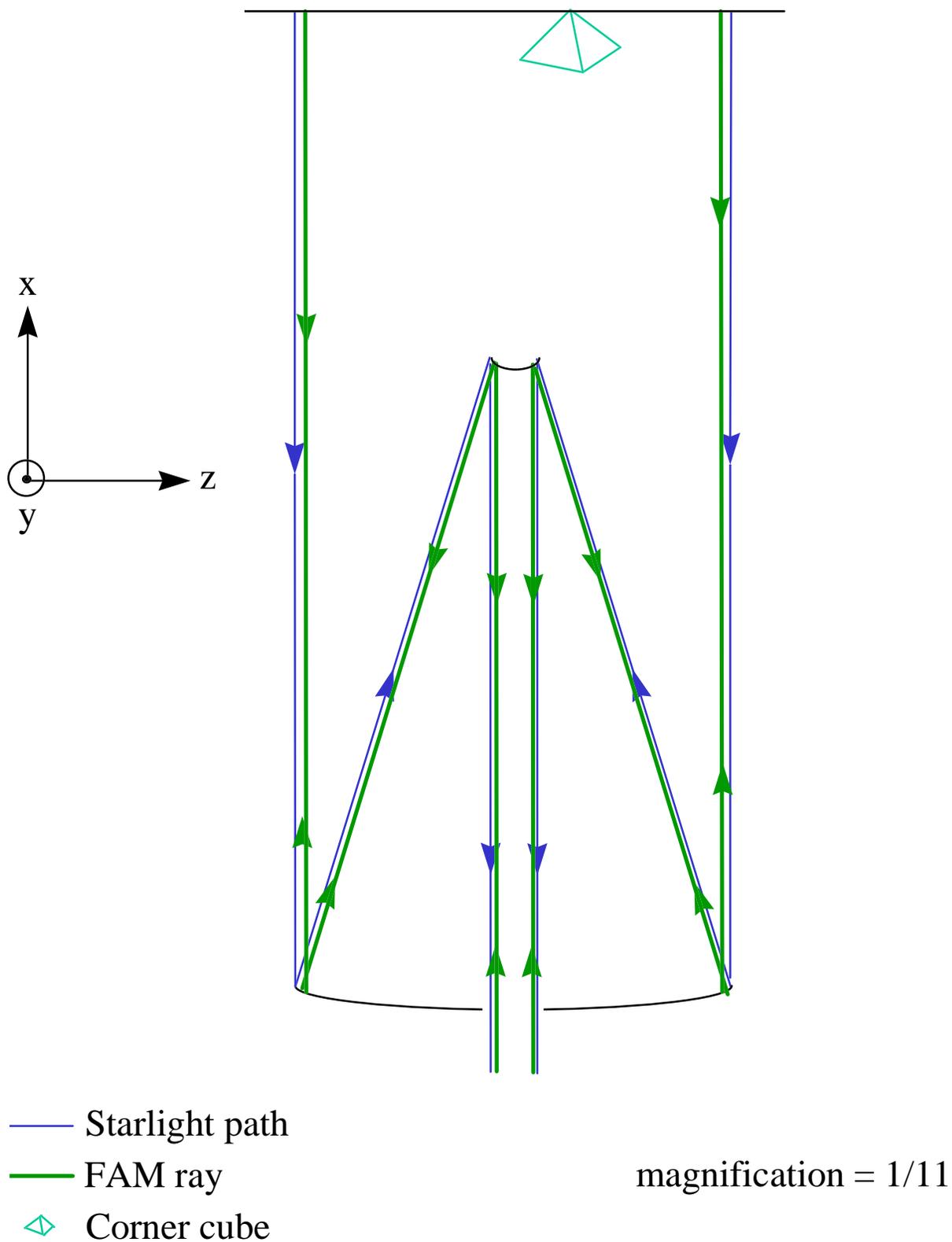
— FAM ray

◊ Corner cube

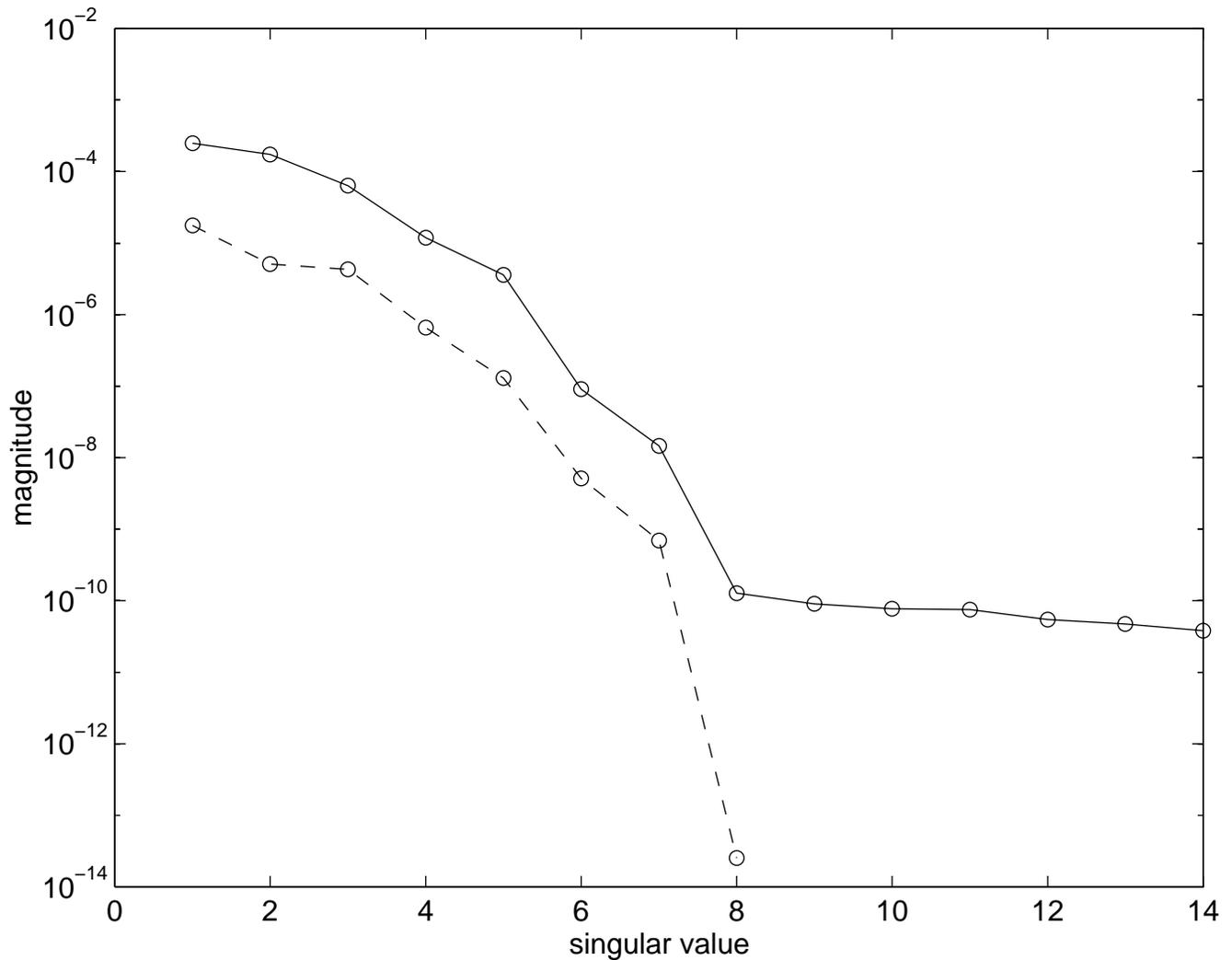
magnification = 1/11

Description	Displacement or angle to cause 10 pm error		
	off-axis, no FAM	off-axis, HOE on primary	off-axis, grating on flat
whole assembly rotates about corner cube	2.9 arcsec	17.0 arcsec	18 arcsec
secondary tip-tilt	0.021 arcsec	0.290 arcsec	0.620 arcsec
despace (\hat{x})	0.60 nm	8.10 nm	37.5 nm
decenter (\hat{y})	$> 1 \mu\text{m}$	$> 1 \mu\text{m}$	$> 1 \mu\text{m}$
decenter (\hat{z})	5.6 nm	85 nm	120 nm

“Gadanken” FAM as a flat mirror



Description	Displacement or angle to cause 10 pm error			
	off-axis, no FAM	off-axis, HOE on primary	off-axis, grating on flat	off-axis, mirror on flat
whole assembly rotates about corner cube	2.9 arcsec	17.0 arcsec	18 arcsec	90.0 arcsec
secondary tip-tilt	0.021 arcsec	0.290 arcsec	0.620 arcsec	41.000 arcsec
despace (\hat{x})	0.60 nm	8.10 nm	37.5 nm	500.00 nm
decenter (\hat{y})	> 1 μm	> 1 μm	> 1 μm	> 1 μm
decenter (\hat{z})	5.6 nm	85 nm	120 nm	> 1 μm



Singular values of the perturbed wavefront: the solid line represents the singular values of the densely sampled pupil and the dashed line represents the singular values of the pupil sampled at the eight points.

